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Agaricus, Steccherinum, and *Typhula* species new for Turkey

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Abstract—Basidiomycetes collected from Tokat and Yozgat provinces during field trips during 2012–18—identified as *Agaricus dulcidulus* (*Agaricaceae*), *Steccherinum oreophilum* (*Meruliaceae*), and *Typhula erythropus* (*Typhulaceae*)—were recorded for the first time for the Turkish mycota. Short descriptions, illustrations, GPS coordinates, and comparisons with similar taxa are provided.

Key words—*Agaricales,* fungal diversity, morphology, *Polyporales*, taxonomy

Introduction

Fungi, among the most diverse organisms in the world, have been estimated to represent approximately 1.5 million species (Hawksworth 2001). Those producing fruitbodies visible to the naked eye are referred as macrofungi, most of which are assigned to two phyla, *Ascomycota* and *Basidiomycota*. Basidiomycetous macrofungi are an important group comprising saprophytic, mycorrhizal symbiotic, and parasitic species that produce fruitbodies in such varied forms as truffles, corals and clubs (clavarioid fungi), jellies, bird's nests, puffballs, conks (shelf fungi), and agarics (gilled fungi) (Andrew & al. 2013; Kinge & al. 2017).

Research on the macrofungal diversity of Turkey, which was first conducted by Vlaev (1915) in European Turkey, has continued to the present day. Sesli & Denchev (2014) reported that 1943 basidiomycetous macrofungal species had been recorded for Turkish mycota up through the end of 2014. Other scientists have also contributed to basidiomycetous macrofungal diversity of Turkey and increased this number (Kaya 2015;

Sesli & al. 2015, 2016; Akata & Sesli 2017; Işık & Türkekul 2017, 2018a,b; Sesli & Vizzini 2017; Türkekul 2017; Uzun & Demirel 2017; Uzun & al. 2017, 2018a,b; Akata & Gürkanlı 2018; Akata & al. 2018; Sesli 2018; Uzun & Acar 2018; Uzun & Kaya 2018a,b; Keleş 2019a,b).

This study should contribute additional knowledge of basidiomycetous macrofungal diversity in Turkey.

Materials & methods

Fresh basidiomata were carefully collected from Akdağmadeni (Yozgat) district and Yaylacık Mountain (Tokat) during 2012–18. The specimens were photographed in the field, and their macroscopic features and ecological features were noted. The fresh specimens were brought to the laboratory, assigned collection numbers, dried thoroughly with an electric heater, and placed into polyethylene bags for further study. Microscopical structures (basidia, basidiospores, cystidia, hyphae) were examined under a compound light microscope in mountants prepared with Melzer's reagent, distilled water, Congo red, methylene blue solution, and KOH. The specimens were identified based on their macroscopic, microscopic, and ecological features by consulting the literature (Moser 1983; Breitenbach & Kränzlin 1986, 1991; Niemelä & Saarenoksa 1985; Niemelä 1998; Noordeloos & al. 2001; Phillips 1981, 2013; Læssøe 1998; Sanyal & al. 2016; Loizides 2017; Putzke & Putzke 2017). The examined specimens were deposited in the Fungarium of the Biology Department, Gaziosmanpaşa University, Tokat, Turkey (ISIK).

Taxonomy

Agaricus dulcidulus Schulzer, Icon. Sel. Hymenomyc. Hung. 2: 29 (1874) Fig. 1

Pileus 20–70 mm diam., ovate at first, later plane to sometimes umbonate, depressed when old, white when young with brown squamules, later lilaceous to vinaceous brown fibrillose with vinaceous brown or purplish brown disk on white ground, white at margin. Lamellae free, close, pinkish brown at first, later dark brown with whitish edge. Stipe (20–) 30–85(–90) × (2–)4–8(–10) mm, central, cylindrical to clavate, bulbous at base, white, yellowish towards base, smooth to fibrillose, annulate. Annulus white, membranous, pendant. Spore print brown.

Basidiospores (4.2–)5–6(–6.5) × (3.1–)4.5–5 µm, ellipsoidal, smooth, inamyloid. Basidia, (19–)22–23(–23.2) × (6–)6.5–6.8(–7) µm, clavate, 4-spored. Cheilocystidia abundant, pyriform to broadly clavate or clavate. Pleurocystidia absent. Clamp connections absent.

Fig. 1. *Agaricus dulcidulus* (ISIK 225): A. basidiomata in situ; B. cheilocystidia and basidium; C. basidiospores; D. hyphae of pileipellis. Scale bars: A = 3 cm; B, C = 10 µm; D = 20 µm.

a
b
c
d

Specimen examined: **TURKEY, Yozgat, Akdağmadeni,** 39°39′95″N 35°56′04″E, 1580 m, among needle litter in *Pinus sylvestris* L. (*Pinaceae*) forest, 27 May 2012 (ISIK 225).

Comments—Although some spores in our specimens are larger, the macro- and micromorphological characters otherwise agree with those cited by Moser (1983), Noordeloos & al. (2001), Phillips (2013), and Putzke & Putzke (2017).

Agaricus dulcidulus (Agaricaceae) is morphologically close to *A. porphyrizon* P.D. Orton and *A. semotus* Fr., but *A. porphyrizon* is separated by its bigger pileus, longer stipe, and habitat preference, growing mostly in deciduous forests (Noordeloos & al. 2001, Phillips 2013). *Agaricus semotus,* which also grows in deciduous forests or among grasses, differs from *A. dulcidulus* by its white to light brown pileus with lilac to reddish-violet fibrillose scales (especially in the centre), double ring, smaller spores, and purple-brown spore print (Phillips 1981, Breitenbach & Kränzlin 1991, Lacheva & Radoukova 2014).

Steccherinum oreophilum Lindsey & Gilb., Mycologia 69(1): 194 (1977) Figs 2,3

Pileus white, effused-reflexed, resupinate, glabrous, stipeless, 6–10 mm broad, margin sinuate when mature, hymenophore odontoid, concolorous with basidiocarp surface. Aculei irregularly flattened and sometimes subulate, confluent or simple, 0.4–2.3 mm long, creamy whitish. Hyphal system dimitic; generative hyphae with clamp connections, thin-walled; skeletal hyphae ≤4(–4.5) µm diam., aseptate, thick-walled.

Basidiospores (5.5–)6–6.5(–7) × (3–)3.2–3.5(–3.9) µm, ellipsoid, smooth, inamyloid. Skeletocystidia long, deep-rooting and tapering (carrot-like), apically encrusted, (79–)85–120(–123) × (6.2–)7–7.5(–9.8) µm. Basidia (9.6–)11.5–16.5(–17.2) × (4–)4.2–4.8(–5) µm, clavate, 4- spored, with basal clamp connections.

Specimen examined: **TURKEY, Tokat, Yaylacık mountain,** 40°31′12″N 36°40′36″E, 1211 m, on fallen and rotten branches of *Fagus* sp. (*Fagaceae*), 27 June 2018 (ISIK 769)

Comments—The specimen we identified as *Steccherinum oreophilum* (*Meruliaceae*) agrees with the literature (basidiospores: 6–6.8 × 3.8 µm, Niemelä & Saarenoksa 1985; 5–6.4 × 2.4–3 µm, Sanyal & al. 2016; 5.5–7 × 2.5–3.5 µm, Loizides 2017).

Morphologically, *S. oreophilum* is similar to *S. ochraceum* (Pers. ex J.F. Gmel.) Gray, *S. bourdotii* Saliba & A. David, and *Irpex lacteus* (Fr.) Fr. Matted pileal surface, cylindrical spines, and smaller basidiospores separate *S. ochraceum* from *S. oreophilum*. In addition to the tomentose pileal surfaces

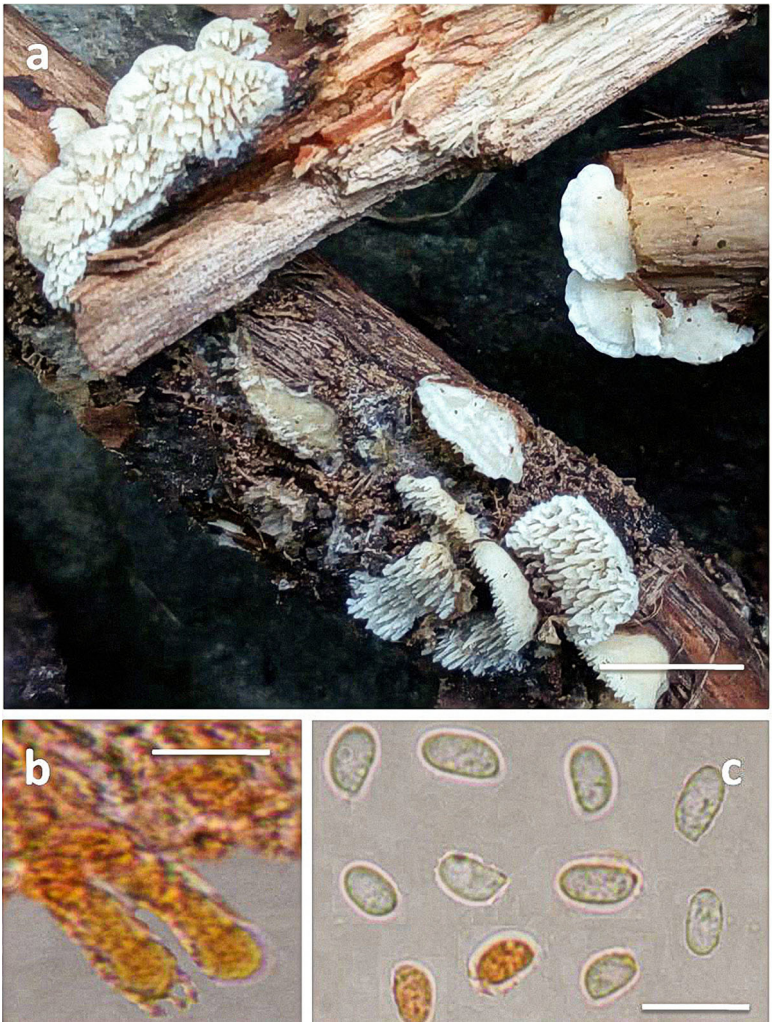


Fig. 2. *Steccherinum oreophilum* (ISIK 769): A. basidiomata; B. basidium and basidiole; C. basidiospores. Scale bars: A = 1 cm; B, C = 10 µm.

of *S. bourdotii* and *I. lacteus,* distinguishing characters include slightly smaller and cylindric spores, an absence of clamp connections, and less strongly encrusted cystidia for *I. lacteus,* while the cylindrical spines and subglobose spores separate *S. bourdotii* from *S. oreophilum* (Niemelä & Saarenoksa 1985, Niemelä 1998).

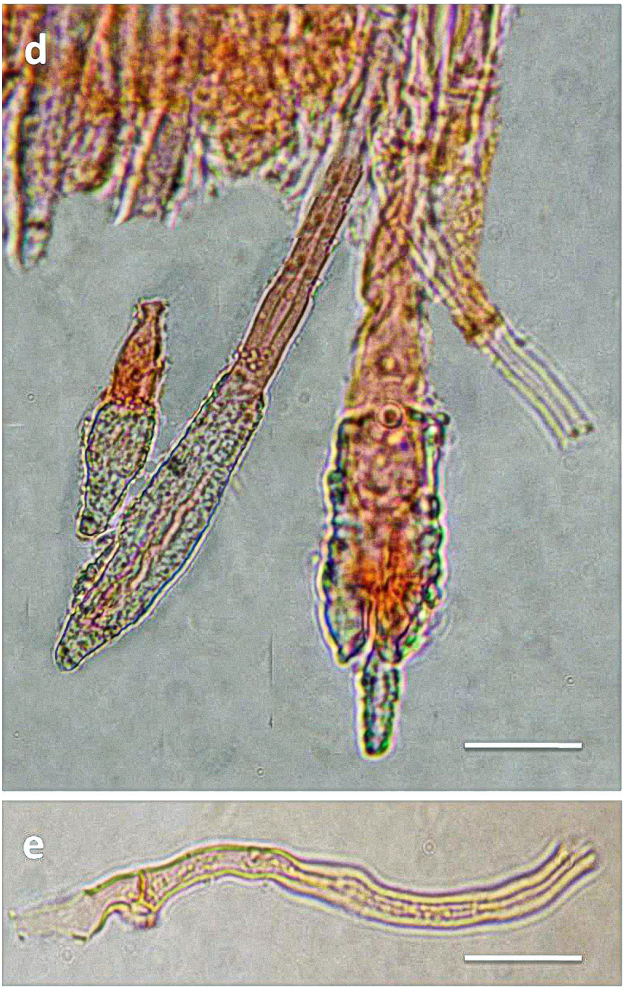
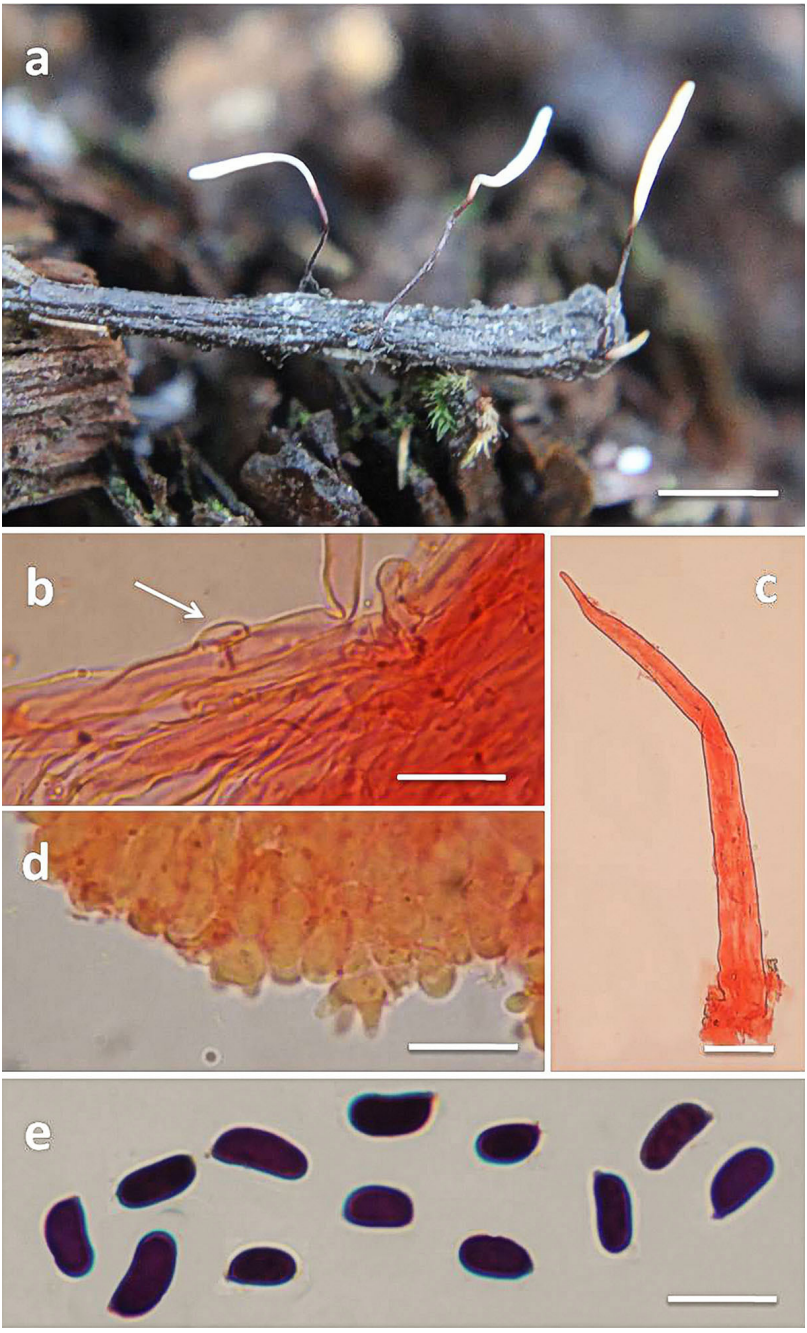


Fig. 3. *Steccherinum oreophilum* (ISIK 769):
D. skeletocystidia; E. hypha with clamp. Scale bars = 10 µm.

Typhula erythropus (Pers.) Fr., Observ. Mycol. 2: 297 (1818) Fig. 4

Fruiting Body (5–)10–30 mm, comprising a fertile head and a long stalk. Fertile head white to creamy white, cylindrical to clavate, smooth. Stalk 0.1–0.3 mm thick and 10–20 mm long, filiform, bended, slender pubescent, cartilaginous, hollow, deep reddish, lighter red towards the apex, arising from

Fig. 4. *Typhula erythropus* (ISIK 751): A. basidiomata; B. stipe hypha with clamp; C. stipe hair; D. basidia; E. basidiospores. Scale bars: A = 1 cm; B, D, E = 10 µm; C = 40 µm.


a
b
c
d
e

a buried blackish sclerotium. Hairs 260–290 × 25–27 µm, pointed at apex, wide at base. Flesh white, transparent especially in fertile head, soft, very thin. Spore print white.

Basidiospores (5–)5.5–9(–9.7) × (2.1–)2.5–3(–3.8) µm., elliptical to oblong, sometimes elongated, smooth. Cheilocystidia not found. Caulocystidia hyaline, thick-walled, subulate, septate. Basidia slightly clavate, 25–40 × 5–6(–6.7) µm, 4-spored, with basal clamp.

Specimen examined: **TURKEY, Tokat, Yaylacık mountain,** 40°31′07″N 36°39′24″E, 1298 m, on fallen leaves and dead branches of *Alnus* sp. (*Betulaceae*), 4 November 2017 (ISIK 751).

Comments—The features of our collected specimen are compatible with published descriptions of *Typhula erythropus* (Phillips 1981, Læssøe 1998, Breitenbach & Kränzlin 1986).

Typhula erythropus (*Typhulaceae*) is easily recognizable by its white club and its red-brown stalk. *T. erythropus* and *T. phacorrhiza* (Reichard) Fr. may be confused with each other due to their similar ecological features, but *T. phacorrhiza* is distinguishable by its longer and honey-yellow fruiting body, absence of an evident club, and bigger basidiospores (Breitenbach & Kränzlin 1986).

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